SP60 Series

SPHERE SPECTROPHOTOMETER

Getting Started

x-rite

The Manufacturer: Der Hersteller: El fabricante: Le fabricant: Il fabbricante:	X-Rite, Incorporated 4300 44th Street, S.E. Grand Rapids, Michigan 49512
Declares that: gibt bekannt daß: advierte que: avertit que: avverte che:	Spectrophotometer SP60 Series

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CE DECLARATION

Manufacturer's Name:	X-Rite, Incorporated
Manufacturer's Address:	4300 44th Street, S.E. Grand Rapids, Michigan U.S.A.
Model Name:	Spectrophotometer
Model No.:	SP60 Series
Directive(s) Conformance:	EMC 89/336/EEC LVD 73/23/EEC

WEEE

As of August 13, 2005, X-Rite products meet the European Union – Waste Electrical and Electronic Equipment (WEEE) directive. Please refer to www.xrite.com for more information on X-Rite's compliance with the WEEE directive.

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This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Industry Canada Compliance Statement

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

NOTE: Shielded interface cables must be used in order to maintain compliance with the desired FCC and European emission requirements.

WARNING: This instrument is not for use in explosive environment.

CAUTION: Operational hazard exists if battery chargers other than X-Rite SE30-81 (115V) or SE30-77 (100-240V) is used. Use only X-Rite battery pack SP62-79-23, other types may burst causing personal injury.

Getting Started

This document is designed to get you familiarized with your X-Rite SP60 Series Spectrophotometer. If you need any further instructions or information, you can find a complete Operator's Manual in a Portable Document Format (PDF) file on the CD that is shipped with your instrument.

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What to do first...

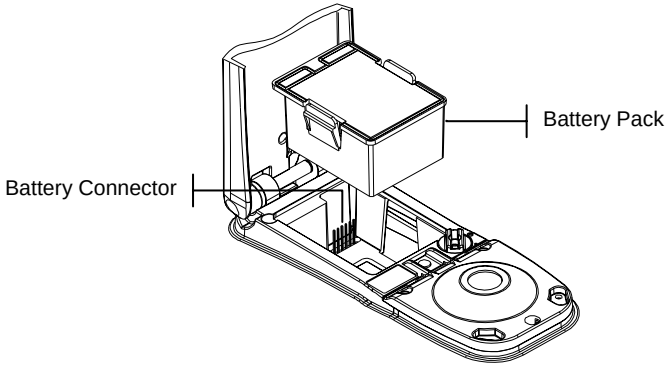
Unpack and Inspect

- Remove the instrument from the shipping carton. Be sure to keep the original carton. If shipment is necessary, the instrument should be packaged in the original carton. Contact X-Rite if you need a new shipping carton.
- Inspect the instrument for any damage. If any damage occurred during shipment, immediately contact the transportation company. Do not proceed with installation until the carrier's agent has inspected the damage.
- Check your packaging contents against your packing list and original order. A detailed packaging drawing and a parts list can be found in the instrument's Operator's Manual.

Install the Battery Pack

The instrument is shipped from the factory with the battery pack removed. The battery pack is located in a carrying case compartment and must be installed before the instrument is used.

1. Hold the shoe next to the instrument housing and lift upward on the spring-loaded latch *(refer to Unlatching the Instrument Shoe)*. Open the shoe perpendicular to the instrument housing.
2. Carefully rotate the instrument over and rest it on its top.
3. Slide the battery pack into the compartment with the battery connector facing down and to the back of the instrument.
4. Press down on the pack until the connector is properly seated and the tabs click into position.



Charge the Battery

NOTE: The battery pack must be installed before plugging in the AC Adapter.

Only use the AC Adapter supplied. The battery pack must remain in the instrument at all times to operate.

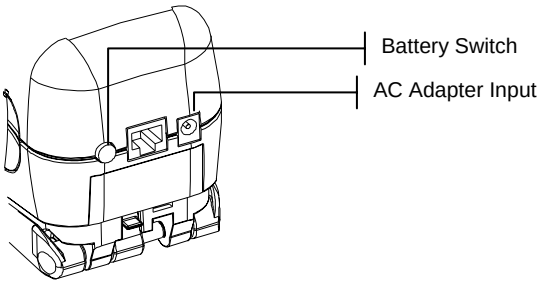
Before initial "remote" use of the instrument, charge the battery pack for approximately four hours. However, if immediate use is required, the instrument can be operated "tethered" to the AC adapter during battery charging.

To attach the AC adapter:

1. Verify that the voltage indicated on the adapter complies with the AC line voltage in your area. If not, contact X-Rite or an authorized representative.
2. Insert the small plug from the adapter into the power-input connector on the instrument. (If you are using serial cable SE108-92, you may insert the small plug into the power connector at the end of the cable.)
3. Plug the adapter into an AC wall receptacle.

Apply Power

The Battery switch—located on the back of the instrument—turns the instrument off and on during battery operation. When the AC adapter is attached, the instrument remains on and the battery switch has no effect.



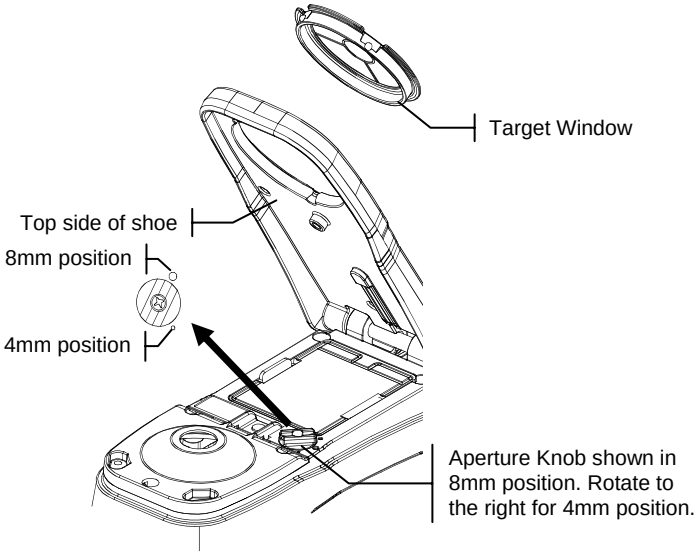
Changing the Aperture Setting (SP64 only)

The standard SP64 can take measurements using either a 4mm aperture or 8mm aperture. Simply rotating the aperture knob and switching target windows changes the setting.

NOTE: The large spot SP64 instrument (14mm) does not have an aperture changing knob.

To change the Aperture Setting and Target Window:

1. Turn the instrument over and rotate the knob to the left for 8mm (large circle indication) setting and to the right for 4mm (small circle indication) setting. The instrument's display informs you of the aperture change. Press the Enter key ↵ to accept the change.


Target Window
Top side of shoe
8mm position
4mm position
Aperture Knob shown in 8mm position. Rotate to the right for 4mm position.

2. Using your fingers, press the target window out from the topside of the shoe. Press against the ring and not the clear window.
3. Note the alignment of the new window and snap it into place from the bottom side of the shoe.
4. Calibrate the instrument to the new aperture setting.

NOTE: The instrument only needs to be calibrated once for each aperture setting. Thereafter, the instrument does not require calibration when switching between aperture settings, until the calibration timer expires.

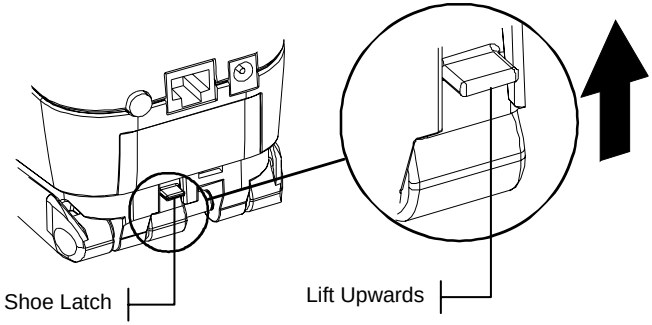
Unlatching the Instrument Shoe

The shoe can be pivoted open 180° from its closed position. This feature is useful when taking measurements on a surface that does not allow room for the shoe, or a measurement fixture that does not require the shoe. Measurements are then activated using the Read key *(see Instrument Configuration for more details on the Read key).*

The shoe must also be open to gain access to the battery compartment when the battery requires replacement.

To Unlatch the Instrument Shoe:

1. Hold the shoe next to the instrument housing and lift upward on the spring-loaded latch.
2. Slowly allow the shoe to pivot toward the back of the instrument and release the latch.

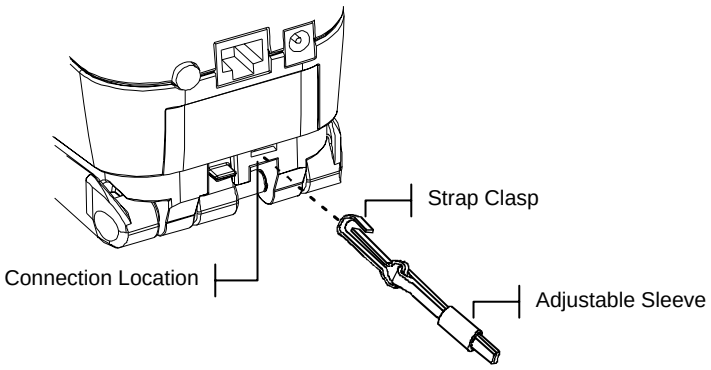


To latch the Instrument Shoe:

1. Simply close the shoe to the instrument. The latch is spring-loaded and automatically latches to the shoe catch.

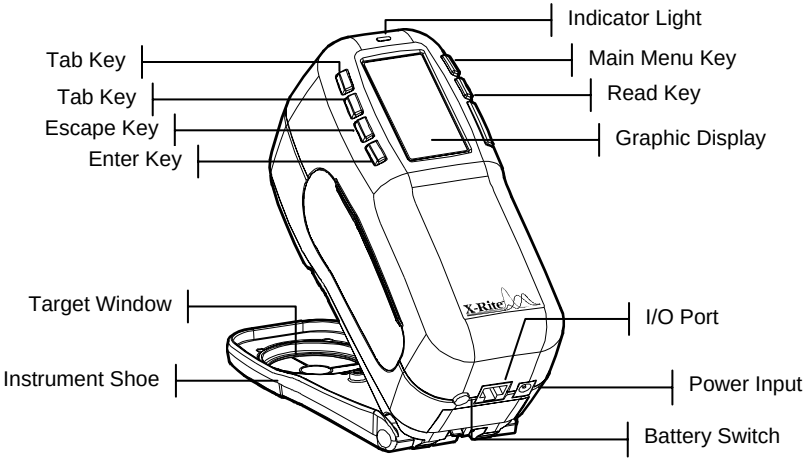
Attaching the Wrist Strap

A security wrist strap is included to safeguard against accidentally dropping of the instrument. The strap is attached to the instrument by simply securing the clasp to the designated location on the back of the housing. Adjust the strap by sliding the sleeve to tighten around your wrist.



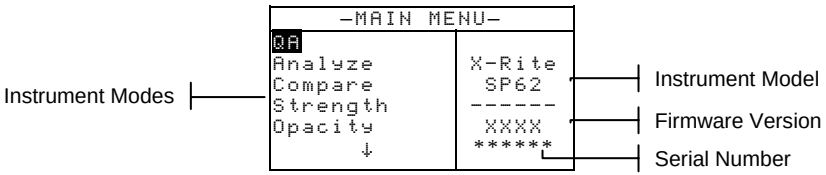
Instrument Description & Features

The X-Rite SP60 Series Spectrophotometer's compact spectral engine utilizes X-Rite's DRS (Dynamic Rotational Sampling) technology, allowing accurate and precise measurements. This instrument has intuitive keys and a high-contrast graphic display. To determine the influence of the specular component, the SP62 automatically provides both specular-included and specular-excluded data.



The Main Menu

When the instrument is powered-up, the main (top level) screen appears. The Main Menu consists of two areas: Instrument Modes and Instrument Data. The left side of the screen lists all available modes. The right side of the screen lists instrument model and firmware version information.



The Keys

Perform reading and menu/option navigation with the six keys arranged around the display screen. Each key has a unique symbol for performing a specific operation.

Tab Down key – advances the highlighted bar (reverse image) to the next available "tab stop." A "tab stop" indicates an item that can be acted on further, such as a measurement or a setting option. Tab stops generally follow a left-to-right or top-to-bottom sequence. When the last tab stop is reached, the next key press returns to the first tab stop in that menu's list. The key is also used to select alpha/numeric characters in the edit mode.

Tab Up key – performs the same function as the Tab Down key except in reverse order. Tab stops follow a right-to-left or bottom-to-top sequence.

Enter key – activates the highlighted item. If the item can be set on or off, pressing the key toggles the option between on and off. When entering an active mode from the main menu, the active mode is displayed with the highlight on the first required operation in the mode.

Escape key – backs up the instrument screen one menu level. For example, if an option or value is being modified at the time the key is pressed, the edits are aborted and the previous screen or menu appears. The only exception to this is when the Enter key is used to toggle an option. In this case, the Escape key exits the menu without aborting the setting.

Main Menu key – returns the instrument screen to the main menu. This is a quick exit out of any mode. If any option or value is being modified at the time the key is pressed, the edits are aborted and the previous setting reinstated.

Read key – if activated in configuration, initiates a reading when pressed. *Refer to Configuring the Instrument for additional information.*

Measurement Screens

The QA, Analyze, Compare, Strength, and Opacity measurement screens consist of three main areas: Data Storage Information, Color Data Parameters, and Color Data.

QA Mode

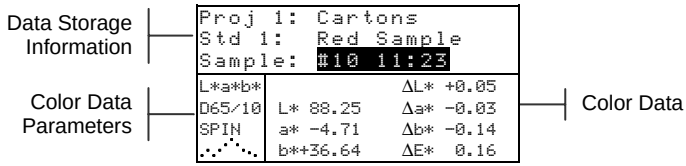
The QA measurement mode can be used in conjunction with a quality assurance software package, such as X-Rite's, X-RiteColor® Master program (SP62 and SP64 only). Projects and standards are downloaded to the instrument and sample measurement pass/fail comparisons are performed.

Analyze Mode
The Analyze mode allows you to take measurements and display the resulting color data (actual and difference) without storing the data in the instrument. Measured data can be transmitted from the RS-232 port.

Compare Mode
The Compare mode is a quick method for comparing measurements without storing the data. After entering the mode, the first measurement is set as the standard and each measurement thereafter is compared to it. The standard can be changed by pressing the Enter key ↵ and remeasuring.

Strength Mode
The Strength mode is used when a colorant is added to a sample to match a standard. The strength method and predicted mode used are selected in the instrument configuration.

Opacity Mode
The Opacity mode is used for making multiple measurement calculations to determine contrast ratio or percent opacity. Each measurement requires three readings (over white, over black, and a measurement of the white backing). The final data can be stored and displayed either as over white, over black, or color at full hide (equivalent color @ 100% opacity) as determined by configuration settings.



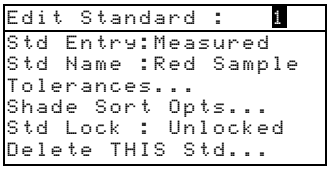
- **Data Storage Information** – When in QA, Strength, or Opacity mode, this area displays the project, standard, and sample information associated with stored data. Repeatedly pressing the Enter key ↵ when `Proj ##` or `Std ##` is highlighted pages through the available projects or standards stored in the instrument (or hold down the Enter key ↵ to access a specific number from the editor dialog). Pressing the Enter key ↵ when `Sample` is highlighted activates the sample Database Tools menu. Pressing the Enter key ↵ when a project name or a standard name is highlighted displays the setup information for the selected item. When the instrument is in storage mode, repeatedly

pressing the Enter key ↵ with the sample number highlighted pages through samples associated with the current standard and project (or hold down the Enter key ↵ to access a specific number from the editor dialog).
When in Analyze mode this area displays the standard's name. Pressing the Enter ↵ key when Std ## is highlighted pages through the available standards stored in the instrument.
When in Compare mode this area displays measurement instructions.

- **Color Data Parameters** – This portion of the screen displays the current parameters for the values displayed in the color data area. *See Selecting Color Data Parameters for additional information.*
- **Color Data** – This portion of the screen instantaneously displays measurement data for the active measurement mode. Depending on the mode and configuration settings, data appears as absolute or absolute and difference values.

Standards Screen

From the Edit Standards screen, standards are viewed, created, edited, and deleted.

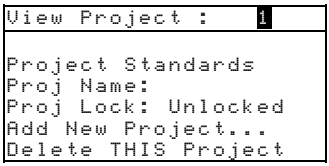


- **Edit Standard: #** – this menu item is used to page to a specific standard location.
- **Std Entry –** this menu item is used to access the editor where standards are measured or entered.
- **Std Name –** this menu item is used to access the editor where a standard name can be entered.
- **Tolerances –** this menu item is used to access the tolerancing editor.
- **Shade Sort –** this menu item is used to access the editor where shade sort size and range are edited.

- **Std Lock –** this menu item is used to change the lock status of the current standard. Locked standards cannot be changed. Downloaded standards cannot be unlocked.
- **Delete THIS Std –** this menu item only appears when the standard is unlocked, and is used to delete the current standard from the instrument.

Projects Screen

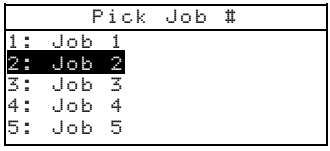
The View Projects screen is used to view stored projects with standard links. Project names and standard links can also be created and edited from this screen.



- **View Project: # –** this menu item is used to page to a specific project location.
- **Project Standards –** this menu item is used to access the editor where standards are linked to the selected project.
- **Project Name –** this menu item is used to access the editor where the project name is entered.
- **Proj Lock –** this menu item is used to change the lock status of the current project. Locked projects cannot be changed. Downloaded projects cannot be unlocked.
- **Add New Project –** this menu item is used to create a new project.
- **Delete THIS Project -** this menu item only appears when the project is unlocked, and is used to delete the current project from the instrument.

Run Job Screen (SP64 only)

The Run Job function is used to select a job sequence downloaded from an X-Rite software program, such as X-RiteColor® Master. A typical job prompts you on the instrument screen with a measurement sequence. Measurement data is then uploaded to the computer for analysis.

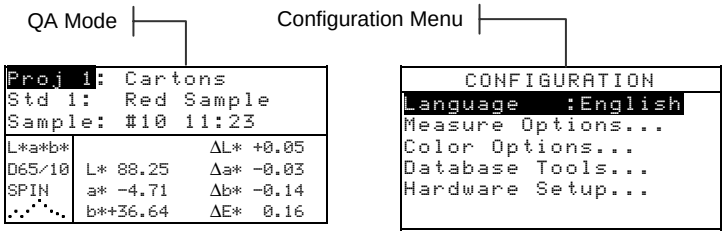


- **#: (Job Name) –** this menu is used to pick the downloaded job. The instrument can store a total of 10 jobs at one time.

Using the Instrument

Opening a Mode or Menu

Opening a mode or menu allows you access to additional items related to the menu or specific information for a mode. Below are examples of typical mode and menu screens.

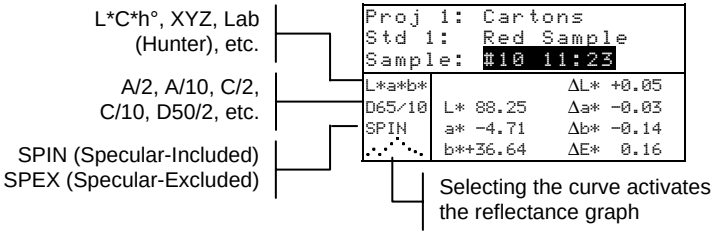


To open a mode or menu:

1. Use the Tab Up key ↑ or Tab Down key ↓ to highlight the desired mode or menu item.
2. Press the Enter ↵ key.

Selecting Color Data Parameters

Measured data can be viewed under varying illuminant observer conditions, specular component (included or excluded) and color space/indices. The active color space/indices and illum/obs are defined in the Instrument Configuration. The color data immediately changes to reflect the selected parameter.

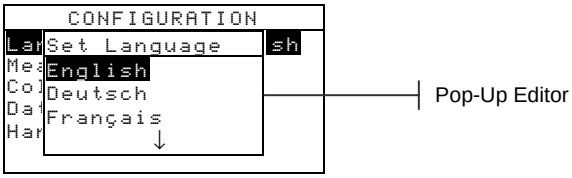


To select a parameter:

1. Use the Tab keys ↑↓ to highlight the desired parameter.
2. Press the Enter key ↵ to page though the available parameters.

Opening a Pop-Up List Box

Opening a pop-up list box allows you to select items and/or change settings for a selection or function. Below is an example of a list box.

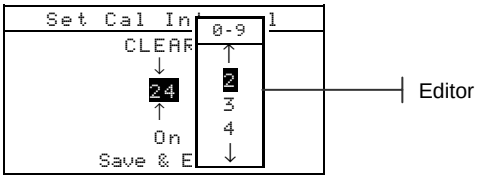


To open an pop-up list box:

1. Use the Tab keys ⇅ to highlight the desired selection or function.
2. Press the Enter ↵ key to access the pop-up list box.

Opening the Alphanumeric Editor

Several functions that utilize names and values are edited using the alphanumeric editor. Selecting `Clear` in the editor provides a quick method of removing all values or characters in the string. Pressing the Tab keys ⇅ simultaneously clears the selected character. Below is an example of the editor.



To open the editor:

1. Use the Tab keys ⇅ to choose the desired digit or number (arrows above and below designate selection).
2. Press the Enter ↵ key to access the editor.

NOTE: If the editor menu includes letters and symbols (such as the standard name editor), you can press the Enter key ↵ again to quickly page through groups of letters, symbols, and numbers.

3. Use the Tab keys ⇅ to highlight the desired item.
4. Press the Enter ↵ key to select the highlighted character and exit the editor.

Selecting Single or Multiple Items

Many settings and modes allow you to select single or multiple items from a list or from a menu. Lists can be found in every type of screen: menus, editors, or mode screens.

To select a single item from a list:

1. Use the Tab keys ⇅ to highlight the desired item in the list.
2. Press the Enter key ↵ to save your selection (and return to the previous screen).

To select multiple items from a list:

1. Use the Tab keys ⇅ to highlight the first item in the list.
2. Press the Enter key ↵ to toggle an arrow (>) on or off for the item (an arrow indicates on).
3. Use the Tab keys ⇅ to move the highlight to the next item in the list and press the Enter key ↵ to set status.
4. Press the Escape key ↖ to return to the previous screen.

Important Measurement Techniques

In order for the instrument to obtain accurate and repeatable measurements, the bottom of the shoe must be flat with the surface to be measured. When measuring curved items where a flat surface is not available, a fixture should be used. A fixture allows accurate positioning of the sample tangent to the measurement plane. If the item to be measured is smaller than the shoe, you may want to make a platform—at the same height as the item—for the rest of the instrument to sit on. The instrument can also be used with the shoe fully extended 180° from the closed position. A measurement is then activated using the Read key.

Instrument Indicator Light

The LED located next to the instrument display illuminates various color conditions during measurements.

- Flashing Amber – instrument calibration is required or measurement aborted.
- Solid Amber – measurement is taking place.
- Solid Green – measurement passed tolerancing requirement in QA mode.
- Solid Red – measurement failed tolerancing requirements in QA mode.

Taking a Measurement

When taking a measurement, be sure to use the previously discussed proper measurement techniques.

To take a measurement:

1. Center the instrument target window over a sample to measure.
2. Lower and hold the instrument down to take a reading. (If the Switch and Key option is activated in the Instrument Configuration, you must also press the **Read** key to initiate a measurement.)
3. Release the instrument, and the measurement data appears.

Calibrating the Instrument

Under normal circumstances, the instrument should be calibrated at least once a day. The calibration procedure consists of a white cal reading and a black trap reading. The instrument features a built in calibration timer that can be set from 1-96 hours. *Refer to Instrument Configuration for procedure.*

Make sure the calibration reference is clean before use. Carefully clean the ceramic disk with a dry, lint-free cloth. Do not use solvents or cleaners of any kind. The black trap portion may also be cleaned with a dry, lint-free cloth or clean, dry compressed air.

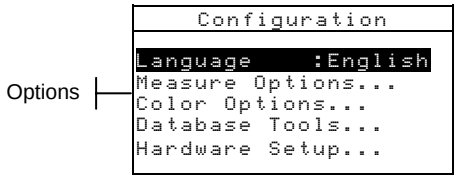
NOTE: The instrument must be calibrated with the target window removed when using the instrument with the shoe extended.

Calibration Procedure

1. Press Tab Up ↑ or Tab Down ↓ to highlight Calibrate. Press Enter key ↵ to access the calibration mode.
2. Position the target window on the white reference.
3. Press the instrument firmly to the shoe. Hold steady until the screen indicates the white calibration is completed. Release the instrument when <Success!> is displayed.
4. Center the target window over the black trap portion of the reference.
5. Press the instrument firmly to the shoe. Hold it steady until the screen indicates the black calibration is completed.
6. Store the calibration reference in a dry, dust free area, away from direct exposure to light.

Configuring the Instrument

You may set up your instrument according to your specific needs. This is done through the Configuration menu. The top level configuration menu has five main option categories that access several sub menus.



Configuration Settings

Use the Operational Steps described in *Using the Instrument* to access and set your configuration options.

Language

The Language configuration allows you to select the language you want to display on your instrument: English, Deutsch, Español, Français, Italiano, or Português.

NOTE: The instrument resets whenever the current language is changed.

Measure Options

The Measure Options configuration allows you to determine the following settings:

- **Store Samples** – Allows you to enable (on) or disable (off) the measurement storage capabilities of the instrument. When set to "On", measured samples are stored in the instrument database until manually deleted.
- **Pass/Fail** – Allows you to enable (on) or disable (off) the pass and fail capabilities of the instrument. When set to "On", the measured data is compared to the current standard value (auto selected as closest color if Auto Std is On) and the associated tolerance to determine pass/fail status.
- **Auto Std** – Sets the automatic standard option. When Auto Standard is enabled (on), the standard with the smallest DE is automatically selected during a difference measurement.

When auto standard is disabled (off), a standard must be manually selected before a difference measurement.

- **Averaging** – Sets the averaging option. Selects the number of readings averaged into a single measurement (0-99).
- **Diff Disp** – Selecting "Numbers" causes delta values to display during difference measurements. This option is automatically enabled when standards are entered or downloaded from a software program. When set to "Words", color differences are displayed as words (e.g., brighter, duller, etc.). This setting is only available for L*a*b* and L*C*h° color difference data. When disabled (off), no delta values are displayed during measurements.

NOTE: No words display for an attribute that is less than $1/7^{th}$ of the DE value. A value less than this amount is considered insignificant compared to the total difference. Delta values greater than 10.00 display numerically.

Color Options

The Color Options configuration allows you to determine the following settings:

- **Active Functions** –Allows you to select the colorimetric functions and indices that are available in the color data parameters. An arrow (>) indicates the function is active.
- **Active Illum/Obs** – Allows you to select the illuminant/ observer combinations that are available in the color data parameters. An arrow (>) indicates the illum/obs combination is active.
- **Opacity** – Determines the data display method for opacity measurements, and allows k1 and k2 value editing.

  Data Display – Select Over White, Over Black, or Color at 100%.
  Set k1 and **k2** – Allows you to adjust the opacity constant of k1 and k2 for SPIN and SPEX.
- **Strength** – Determines strength method and predicted mode.

  Method – Select Apparent, Chromatic, or Tristimulus as the strength calculation.
  Predicted is @ – Select 100% or MinΔE as the predicted mode.

- **Metamerism Index** – Determines the metamerism mode and Illuminant/Observer pairs used in calculating the metamerism index.

  Mode – Select MI or DIN6172 as the metamerism mode.

  IllObs1and **IllObs2** – Select the illuminant observer combinations (D65/2, D65/10, etc.).
- **ΔEcmc Factors** – Used to edit the Lightness and Chromaticity values for the selected calculation.
- **ΔE94 Factors** – Used to edit the Lightness and Chromaticity values for the selected calculation.
- **Shade Sort** – Allows you to enable (on) or disable the shade sort capabilities used in the QA mode. Shade sort options are accessed through the Standards mode and allow setting the shade sort range and box size.
- **SP88 SPEX Mode** – When enabled (on), specular values are calculated the same as X-Rite's SP88 instrument.

Database Tools

The Database Tools configuration allows you to determine the following settings:

- **View Tags** – Used to view the current tags that were scanned in the instrument. Individual tags can be deleted from this screen.
- **Factory Presets** – The instrument can have its factory defaults reloaded whenever required**. All configuration options and stored data will be lost.**
- **Clear all Databases** – Allows you to clear all stored data from the instrument. Configuration settings are not affected.
- **Clear all Samples** – Allows you to clear all stored samples.
- **Clear all Tags** – Allows you to clear all stored tags.
- **Clear all Projects** – Allows you to clear all stored projects.
- **Clear all Jobs** – Allows you to clear all stored jobs (SP64 instrument only).
- **Clear all Standards** – Allows you to clear all stored standards.

Hardware Setup

The Hardware Setup configuration allows you to determine the following settings:

- **Serial Port** – Allows you to edit the following settings which affect data transmitted from the RS-232 port.

  Baud Rate – Choose the correct baud rate.
  Hand Shake – Set the method of handshaking between the instrument and your computer. There are four handshake methods: Off, CTS, BUSY, or XON.
  Auto XMT – Enable (on) or disable (off) automatic transmission of measured data.
  Separator – Determine the character that separates the data components of a measurement: Space, Comma, Tab, CR (carriage return), CRLF (carriage return, line feed), LF (line feed).
  Delimiter – Determine the character that terminates the string of measured data: Space, Comma, Tab, CR (carriage return), CRLF (carriage return, line feed), or LF (line feed).
  Set Data Types – Determine the type of data that is transmitted after a measurement (if Auto XMT is on or when requested by an RCI command). Available data types are SPIN Colorimetric, SPEX Colorimetric, SPIN Reflectance, and SPEX Reflectance.
  Header – Enables (on) or disables (off) the header from printing during a data transmit.
  Std Printout – Enables (on) or disables (off) the standard from printing during a data transmit. If "Diff Disp" is turned off in Measure Options, no standard will print regardless of this setting.
  Emulation – (SP62 and SP64 only) Enables the instrument to emulate other instrument outputs. When set to Off, the instrument communicates normally. When set to SP68, the instrument duplicates the SP68 communication (including RCI version command response) allowing communication with older X-Rite software packages (QA-Master, Paint-Master, etc.).

- **Read Oper.** – Determines the method that is used to take a measurement.

  RCI Only – A measurement can only be initiated through an RCI command via the RS-232 port.

Switch Only – The instrument read switch initiates a measurement.
Key Only – The Read key on the instrument must be pressed to initiate a measurement.
Switch and Key – Both the instrument's read switch and read key are required to initiate a measurement.

- **Cal Timeout** – Determines the "cal interval time" desired between calibrations. Time is set in hour increments and can also be set to Off. When a calibration is required, a message appears on the instrument screen informing you that a calibration is needed.
- **Power Down** – Determines the amount of time the unit remains on without any use before turning itself off. This configuration only affects the instrument when the charger is *not* connected. This value can range from 10 to 240 seconds.
- **Beeper** – Sets the volume of the beeper: Loud, Medium, Soft, or Off.
- **Clock Adjust** – Used to adjust the internal clock of the instrument.
- **Display** – Allows you to determine the following settings:

  Contrast – Set the contrast of the display for optimal viewing. The setting can vary from 1 to 99.
  Orientation – Determine whether you want the display viewable for right-handed (right) or left-handed (left) use.
  Security – Enable (on) or disable (off) the entire Configuration options menu. *See following steps to access the Configuration menu when Security is enabled.*

  To gain access to the Configuration menu if Security is enabled:

  1. Remove the AC adapter and turn off the instrument with the battery switch.
  2. Press the Read key as you turn the instrument on with the battery switch.
  3. When the main menu appears, release the Read key. The Configuration item appears in the main menu.

  NOTE: You must set the Security to **Off** if you want the Configuration item to automatically appear the next time you turn the instrument on.

Error Messages

Errors encountered during a measurement are displayed on the instrument screen. All errors are accompanied by a long beep and flashing yellow light. The error message is cleared from the instrument screen by pressing the Enter key ↵ .

Displayed Errors:	Reason
Measurement was aborted by user	Displays with an incomplete measurement or calibration. Instrument was released too soon.
Calibration has timed out	The calibration interval time set in the configuration has been reached. Calibration is now required.
Calibration required	Displays anytime the instrument requires a calibration.
Calibration has failed	Calibration failed. Make sure the instrument is properly positioned on the reference.
The battery is getting low	This warning appears when the battery falls below approximately 25% of full charge. Measurements are still possible, but the battery should be charged soon.
Batteries are dead	Displays when not enough battery power remains to take measurement. The current measurement is aborted.
Batteries are missing	The battery pack is not installed. Instrument will not allow any measurements.
Incorrect Charger Voltage	Wrong charger is connected or charger is bad.
The battery is over-charged	The battery pack is too hot. Remove battery pack and let it cool off.
Lamp is getting weak, replace soon	Reading lamp is at 50% strength or less from its original intensity. Measurements are still possible but the lamp should be replaced soon.

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